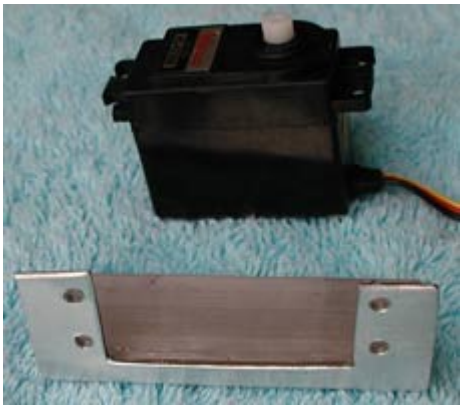
Parts Needed:

- **Bucky Skull** (see page 2 for details)
- **Standard servo** (HiTec HS-425BB or equiv. See details at ServoCity)
- **2-3/4" long 1"x1"x1/16" angle aluminum** (available at home centers-Home Deopt and Lowes-or hardware stores)
- **0.039" Music wire** (available at most "real" hardware stores and most hobby shops, here's one source, item #597279)
- **1 1/2" #6 screw, nut, washer**
- **Servo mounting hardware** (#4/40 screws and nuts)
- **2-4" Cable ties** (aka: tie wraps, zip ties)

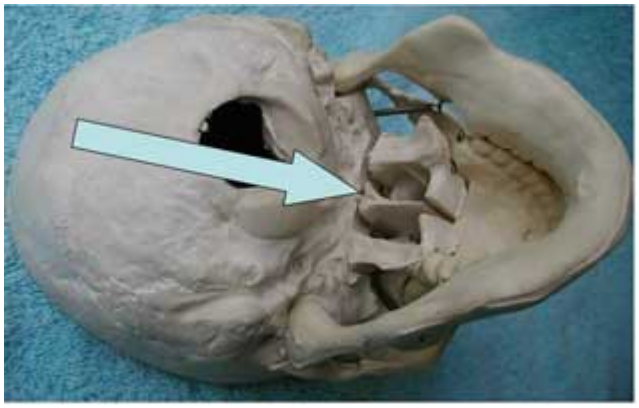
Click on the images to enlarge them

Note: The following procedure has been modified as of 2/2005 to accommodate the newer Bucky skulls, which can be identified by the "Made In China" label on the back. If you have an older Bucky skull, click here for the original instructions.

We need to make a bracket that will allow us to mount a servo on the area marked by the dotted line.



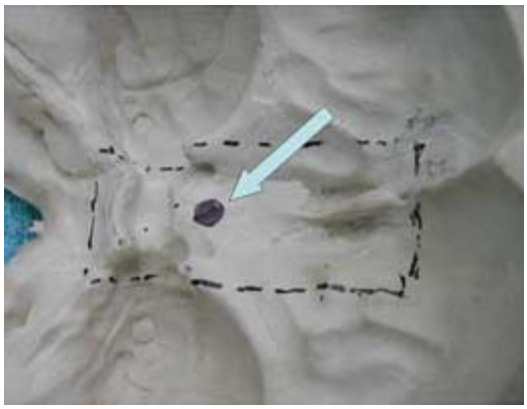
Using the appropriate tools (hack saw, tin snips, file, etc.) cut an opening in one side of the aluminum angle to accommodate the servo. Be sure to leave some of the "angle" to maintain strength. Drill holes to match the servo mount for 4/40 screws. This will be our servo bracket.



To mount the servo bracket in the skull, we'll want to drill a hole that comes out in the nasal cavity. We'll need to cut away part of the bone that divides the nasal cavity (the septum) as

shown by the arrow.

Using tin snips or diagonal cutters, snip away the rear portion of that bone. I've found that in most skulls, this piece is loose and after you cut it, it is easily removed. This will leave a nice flat surface (right) to accommodate the nut and washer in the next steps.



On the inside of the skull, right above the flat area shown above right, make a mark. Place the

servo bracket where it will be mounted and transfer this mark to the bracket.

Using the appropriate size drill bit for a #6 screw, drill a hole through the bracket and skull where they were marked.

Using the #6 screw, nut and washer, mount the servo bracket in the Bucky skull. Tighten securely but don't over

tighten as it might bend the bracket.

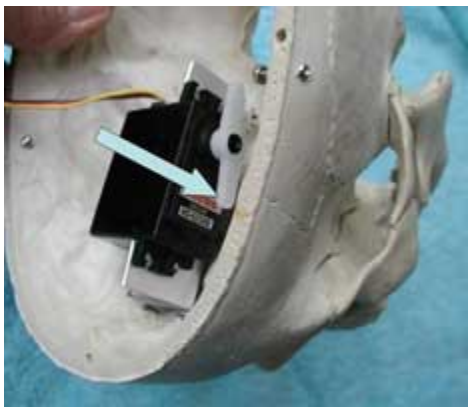
Bucky's jaw is held in place by a pair of springs. We need to install a permanent pivot for the jaw and also eliminate the springs because they are too much mechanical resistance for the servo. We'll use the cable ties as our pivot.

Using a drill bit the same size as the cable tie, drill a hole through the jaw and into the skull as shown right. Drill

a second hole into just the skull, to the rear of the jaw bone as shown far right.

Insert the cable tie from the inside the skull down into the jaw bone, loop it back into the skull through the second hole (right) and fasten it inside the skull. In fastening the cable tie, tighten it just enough so the jaw won't flap around but still has freedom to move.

Repeat the same for the other side of the jaw then remove the springs and all associated hardware.



The next step is to drill a hole in the skull that will allow us to connect the servo to the jaw using a piece of the music wire. The wire will run from the front of the servo horn (left) to the hole in the left side of the jaw where the spring was originally mounted (right).

While holding the servo in place, make a mark on the skull in line with the two points described above (left). Drill a 1/4" hole in the skull at this mark. If you were really good (lucky?), the hole will line up perfectly between the two points, if not, you'll have to "modify" the hole slightly to be in line.

Next, using a pair of long nose pliers, create an offset bend, as shown left, in one end of a 6" piece of the music wire. Attach it to the outer hole in the servo horn as shown right.

Feed the wire through the hole and install the servo in the bracket using the #4/40 screws and nuts. I find that using just two screws will hold it securely in place.

In preparation for the next step, position the servo horn as shown right.

With the servo horn in the position shown above and the jaw fully closed, bend the music wire at the point adjacent to the hole in the jaw (left). Complete the installation by inserting the wire in the jaw hole, bending it upward and trimming it off as

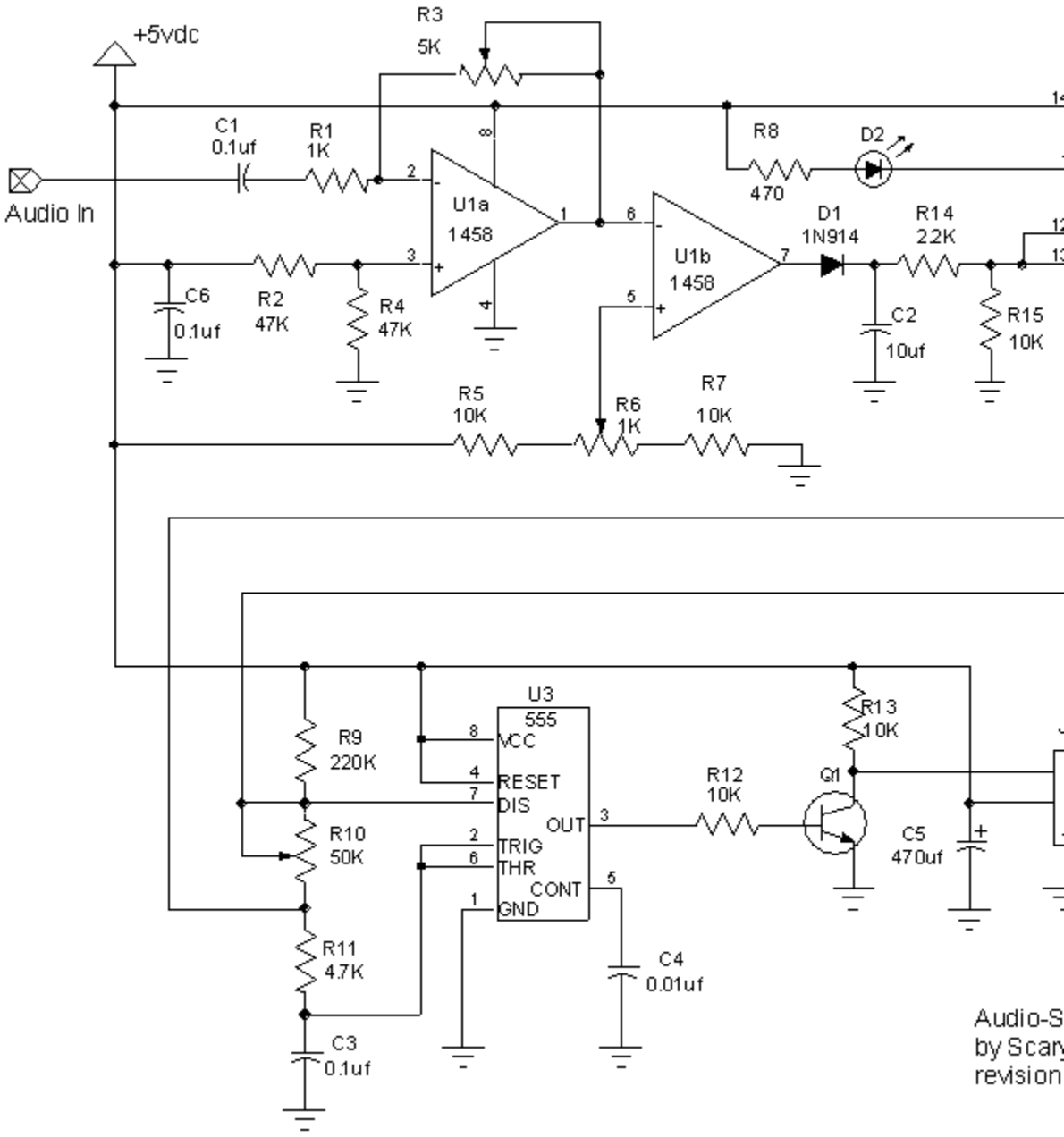
shown right.

At some point, you're probably going to need to adjust the position of the servo horn on the servo. I recommend drilling a small hole in the side of the skull, as shown left, to accommodate a small phillips screwdriver. Be careful when drilling the hole so as not to slip and drill out the center core of the servo (please don't ask me how I know about this).

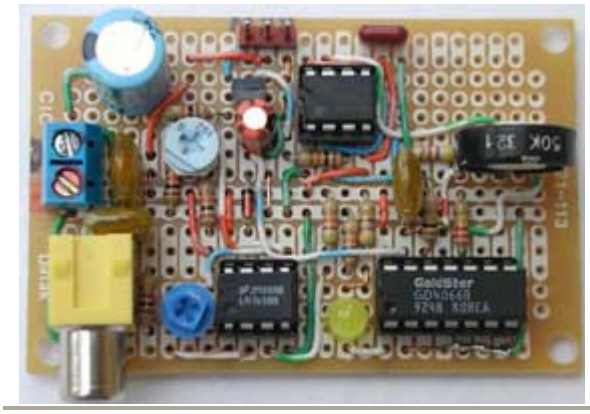
First of all, if you want to do it the *easy* way.....

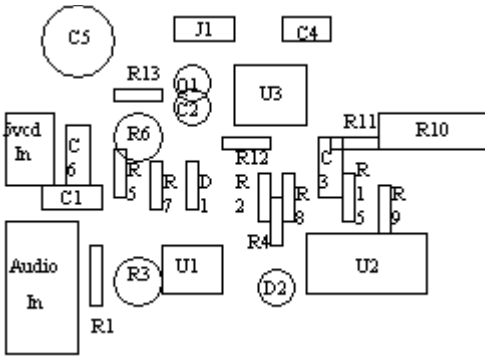
Cowlacious Designs offers this circuit as a kit (or completely assembled). Believe me, this is a much easier way to build this circuit than trying to do it from scratch and the kit is only a few bucks more than buying the individual parts. *(Note: I am not affiliated with Cowlacious Designs. I have given them*

permission to use my design, but I make no money from the sale of the product).

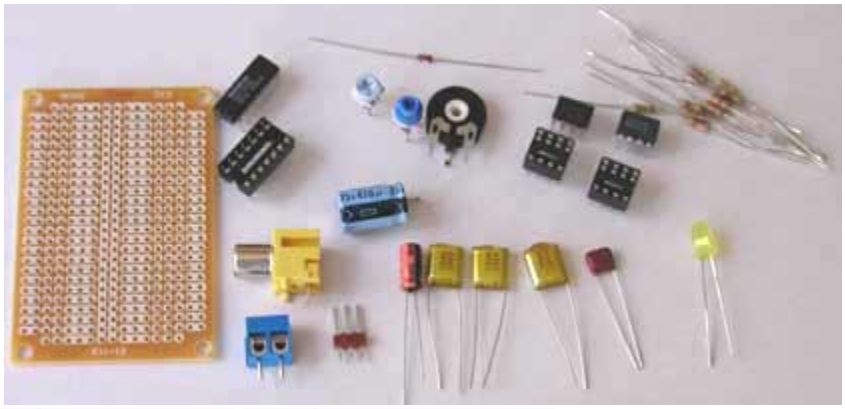


Click on the schematic
for a pdf version.





Parts List



C1	0.1 uf 50 volt capacitor
C2	10uf 35 volt capacitor (see text below)
C3	0.1 uf 50 volt capacitor
C4	0.01uf 100 volt capacitor
C5	470 uf 35 volt capacitor
C6	0.1 uf 50 volt capacitor
R1	1k 1/4 watt

R12	10k 1/4 watt resistor
R13	10k 1/4 watt resistor
R14	2.2k 1/4 watt resistor
R15	10k 1/4 watt resistor
U1	1458 dual op amp
U2	4066 cmos quad switch
U3	555 timer
D1	1N914
D2	LED
Q1	2N2222 npn transistor
J1	3 pin male jack for servo

	resistor
R2	47k 1/4 watt resistor
R3	5k trimmer pot
R4	47k 1/4 watt resistor
R5	10k 1/4 watt resistor
R6	1k trimmer pot
R7	10k 1/4 watt resistor
R8	470 ohm 1/4 watt resistor
R9	220k 1/4 watt resistor
R10	50k trimmer pot
R11	4.7k 1/4 watt resistor

	connection
	Two 8 pin IC sockets
	One 14 pin IC socket
	Audio Connector (your option)
	Power Connector (your option)
	Circuit board (it will all fit on a Radio Shack 276-150 or equiv.)

Circuit Description From the output of your audio source, the center conductor goes to "Audio In", the outer shield goes to ground. The signal is amplified by U1a whose gain is controlled by R3. You should be able to use audio sources from a line level to a "reasonable" speaker level source and adjust the gain using R3. U1b compares the audio from U1a to a reference voltage set by R6 and sends a switched output voltage through diode D1 to CMOS switch, U2. R6 should be adjusted so that with no signal, LED D2 just turns off. Once a signal is present, R6 can be used to fine tune the servo action. Capacitor C2 is used to smooth the servo operation. I show a 10uf capacitor but have used values as low as 2.2uf depending on need. Lower values make things jerky, higher values slow down the servo action. I recommend experimenting to find out what's best for your situation. You may want to consider just putting in a 0.1" spacing socket in place of C2 so it will be easy to substitute different value capacitors. That's how Cowlacious is shipping their kits now.

U2 is simply used as a switch. In this case, a high on pin 12 closes a switch between pins 10 and 11, triggering the servo driver (actually, it's not a full closure but about 90 ohms of resistance). A high on pin 13 closes the switch between pins 1 and 2, which is what lights the LED. (The LED is optional, but it really makes it easier to make adjustments and insure the circuit is working correctly. If the LED is not used, pin 13 should go to ground). There are two additional switches that may be used in this IC, pin 5 controls the switch between pins 3 and 4, and pin 6 controls the switch between pins 8 and 9.

The circuitry surrounding U3 is the servo driver. In its original form, the circuit was a "servo tester". I've made some modifications to make it suitable for this application. Variable resistor R10 sets the *starting point* of the servo, so at one extreme, the servo will start at 0 % and go all the way to 100% while at the other extreme, the servo will start at 99% and go to 100% of its travel. Capacitor C5 helps to keep the power supply stable during servo

operation. J1 is the connector for the servo.

This circuit, without a servo attached, only draws about 2 ma, but actively driving a servo, draws around 600 ma. I'd recommend a 5 volt power supply of at least 1 amp. I've found a good source for this type of supply is All Electronics.

My favorite place to purchase servos is ServoCity. They've got good prices and I've never had any problems with their service. My current favorite standard servo is the Hitec HS-425BB. With dual ball bearings and nylon gears, it's a good compromise between performance and price.

I've had a report of one guy driving seven servos off the one circuit and it worked fine. The important thing to keep in mind when driving multiple servos is that you need a power supply that will handle the combined current of the servos.

For reference, here are part numbers and prices for DigiKey, taken from their web site 7/2005.

Part	DigiKey number	cost each	Total
C1,C3,C6	P4593	1.29/10	1.29
C2	P1187	0.24	0.24
C4	P4797	1.16/10	1.16
C5	P10301	0.72	0.72
R1	1.0KQBK	0.28/5	0.28
R2, R4	47KQBK	0.28/5	0.28
R5, R7, R12, R13,	10KQBK	0.28/5	0.28

R15			
R8	470QBK	0.28/5	0.28
R9	220KQBK	0.28/5	0.28
R11	4.7KQBK	0.28/5	0.28
R14	2.2KQBK	0.28/5	0.28
R3	AAS53CT	0.50	0.50
R6	AAS13CT	0.50	0.50
R10	AAS54CT	0.50	0.50
U1	LM1458NFS	0.55	0.55
U2	CD4066BCN	0.48	0.48
U3	LM555CNNS	0.86	0.86
D1	1N914TRCT	0.10	0.10
D2	67-1110	1.15/10	1.15
Q1	PN2222AFS	0.20	0.20
8 pin ic socket	ED3108	0.32	0.64
14 pin ic socket	ED3114	0.57	0.57
J1	WM4001	0.41	0.41
Circuit Board	*Radio Shack* 276-150	1.79	1.79
TOTAL			13.30

As I mentioned at the beginning, the servo will respond to any sounds it's given, so if you have a voice track with music in the background, the servo will not only respond to the voice but the music as well. Jeff Stevens had a way to solve this problem and here is his email to me.....

> Dear Scary-Terry, I am writing you about a new method for using your audio-servo driver. Here’s how you do it. First, you record your sounds on a two channel cd and player. On one of the channels have the voice and all other audio effects that you want people to hear, such as music or thunder etc. On the other channel, whether it is the left or right it doesn’t

matter, you record the sounds that you want to drive the audio-servo driver. You connect this channel to the audio driver. You then use a y-splitter to take the first channel, the one you want people to hear, and connect it to both channels on the amplifier or amplified speakers. You now have the ability to have music without it activating the skull. The effect sounds stereo because it is coming out of two speakers, but both are playing the same thing. That is the only disadvantage. Let me know what you think.